Section 2. Vision and Design Elements

School facilities must be designed and built to help support the preparation of students to be productive citizens in the 21st century world we know today, yet have lasting capacity and flexibility to prepare students for a future we have just begun to envision.

This section of the facilities guide includes the following subsections:

- The Design Process
- Revitalizing Learning Environments with Educational Technology
- Guiding Truths and Assumptions
- New Role of Schools

I. The Design Process

The design of technology-rich classrooms and schools has to be a collaborative process and the voice of a broad spectrum of stakeholders must be heard in all of the planning and design stages. Teachers, students, technology staff, administrators, support personnel, board of education members and community members will provide valuable input when engaged properly. There should, however, be a process for developing an overarching philosophy regarding educational technology that all parties agree meets the vision of the district and the Department of Education. Key stakeholder involvement during the design process is further discussed in Section 3 of this document.

One of the several challenges faced by the design consultant is that of creatively balancing the need for flexibility and future proofing against the constraint of a project budget. There is no single classroom design that can offer the "right" solution for all circumstances. Nor is it possible to see into the future and discover what teaching methods and educational technology components will be used ten years from now. The design consultant must gather as much information as possible through research and outreach to the key stakeholders and use current best practices that reflect existing and emerging technology standards.

A. Design Process and Philosophy for Educational Spaces

One of the key objectives of this facilities guide is to provide information to help districts ensure that their technology infrastructure and systems are educationally adequate, include room for expansion, and are driven by the programmatic needs of the district, school, teachers, and students. The design process for a school building begins with the formulation of a building program based on information gathered from all key stakeholders. The information gathered is organized and presented within a document called the educational specification (Ed Spec).

During the formulation of the Ed Spec, the design consultant should engage all stakeholder groups and elicit from them information on a wide array of issues. Information gathering methods that have proven successful in the area of educational technology include the following:

- Forming a committee of teachers, administrators, support staff, students, board of education members and community members who represent all stakeholders involved with school use and function.
- Collecting input from the community at large via town hall discussion, survey, or other strategy that has proven effective in the past.
- Organizing onsite or virtual (if available) visits to newly built and retrofited schools or classrooms.
- Holding small-group work sessions where ed spec committee members collaborate on room layouts and device locations for a variety of room types.
- Reviewing previously developed planning documents, such as the current technology plan, long-range facilities plans, district strategic plan, New Jersey State Educational Technology Plan, and the National Technology Plan. Technology plan documents often contain language that can be adopted for the overarching educational technology philosophy statement referred to previously.
- Arranging for presentations (onsite and virtual) by experts who specialize in K-12 technology vision, products, and services.

Discussions must also take place regarding how the school/district's special education populations, at-risk populations, English Language Learners and students receiving remote services will be accommodated. Specialists in the area of assistive technologies and universal access/universal design techniques should also be included in discussions of spaces for special populations.

B. Total Cost of Ownership (TCO)

No school should be built without a plan for ongoing upgrades and maintenance of the resources installed. The focus should be on minimizing the total expenditures over the life of the system. This may mean that a more expensive, yet also more efficient, system should be initially acquired in order to take advantage of reduced operation and maintenance costs later on. Spending additional money up front to design flexibility and accessibility into building plans is money prudently invested when compared to the cost of retrofitting classrooms and labs after construction is complete.

Current strategies to address reducing long-term costs at the onset of planning include designing schools that take full advantage of natural resources, environmentally friendly solutions, and SMART design concepts. More information on these topics can be found at the following Web sites:

- Energy Star, Schools, An Overview of Energy Use and Energy Efficiency Opportunities, http://www.energystar.gov/ia/business/challenge/learn_more/Schools.pdf
- School Planning & Management, April 2008 Special Green Issue, Estimating the Cost of LEED in Schools and Green Schools from A-Z, http://www.peterli.com/spm/cover/tocspm.pdf
- US Green Building Council, LEED for Schools, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1586

- Build Green Schools, LEED for Schools – For New Construction and Major Renovations http://www.buildgreenschools.org/documents/leed-s_ratingsystem.pdf
- AIA – The American Institute of Architects, Sustainability, http://www.aia.org/susn_rc_default
- DSIRE – Database of State Initiatives for Renewable & Efficiency, Energy Efficiency in New School Construction, http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=NJ14R&state=NJ&CurrentPageID=1&RE=1&EE=0

As detailed in Section 3 (School Construction Process) of this document, the design consultant is responsible for providing cost estimates at various stages of the project. The IT staff/IT review committee should review equipment and installation estimates and also seek estimates on upgrade and replacement cycles and ongoing maintenance costs.

Technical support and end user support staff costs must also be considered when calculating TCO. Districts must understand the impact of various educational technology system choices on the IT staffing requirements. For example, a decision to give wireless laptops to a large group of students requires that additional support staff and/or computer maintenance costs be added to the TCO equation. Another example would be the extra dollars and time spent on supporting older equipment. A decision not to spend money on new computers is not necessarily a no-cost decision.

Although the primary intent of this document is to address infrastructure design and implementation which should serve the district for 10+ years, it is also the responsibility for each district to establish, implement, and fund a refresh cycle for computing resources. Even the most robust infrastructure will not be able to compensate for aging desktop and laptop devices over time.

Tools that will assist in the TCO process can be found at:

http://classroomtco.cosn.org/ and www.iaete.org/tco

II. Revitalizing Learning Environments with Educational Technology

The technology infrastructure of the 19th and 20th centuries is no longer keeping pace with the needs of the 21st century learner. New, flexible environments that encourage communication, collaboration, production, and innovation are required to support student learning of core content knowledge using 21st century tools, while also developing critical 21st century skills to meet the NJDOE vision of a 21st century education.

This section of the facilities guide focuses on how school designs must respond to:

- Educational Technology Advances
- The Need for High Speed Connectivity
- Ubiquitous Access to Computing Resources for Teaching and Learning

A. Educational Technology Advances

The Department of Education's ongoing vision for educational technology in New Jersey's Schools is documented in *Preparing Today for Tomorrow: The Educational Technology Plan for New Jersey* (http://www.state.nj.us/education/techno/state_plan.htm). This plan documents the role of educational technology in promoting students' academic achievement. (See Appendix C)

The educational technology information presented in this guide is intended to complement and align directly to the vision statement presented in the "New Jersey State Educational Technology Plan". This **vision statement** reads:

All students will be prepared to meet the challenge of a dynamic global society in which they participate, contribute, achieve, and flourish through universal access to people, information and ideas.

The following statements further articulate the benefits that educational technology will bring to the 21st century:

- Learners will experience quality time-on-task and access resources using one-to-one networked computing classrooms and learning environments. They will engage in self-learning through Web-based research, collaborative work, critical thinking, and problem-solving activities with real-world, culturally-relevant, and appropriate content in all subject areas.
- All learners will benefit from personalized and managed learning around their interests, developmental levels, and preferred learning styles and modalities.
- Diverse and technology-rich learning resources will enable students to coordinate where they prefer to learn to what they want to know; how they learn best; and when they need to learn. They will use a wide variety of learning technologies that include graphing calculators, portable computing devices, handheld computers, mini-laptops/ultra portables, interactive white boards, digital cameras, and a wealth of other content-specific digital resources.
- Students will benefit from learning opportunities that include technology-rich environments that mirror the way that technology is used within institutions of higher education, the workplace, and in the global community.
- Schools will be viewed as an integral part of their neighborhoods and communities, allowing the community into the school and the school into the community. School facilities will provide a meeting space for community activities and a learning space for people of all ages to grow together, while representing a shared community vision of contribution through collaboration.

B. High- Speed Connectivity

In 2008, SETDA (State Educational Technology Directors Association) issued a report entitled "High-Speed Broadband Access for All Kids: Breaking Through the Barriers". In that report, SETDA identified several issues facing the educational community related to high-speed connectivity. Some of the key issues follow:

- Teachers and students need high-speed broadband access in their schools to take advantage of a wide range of new and rich educational tools and resources available for learning anytime, anywhere.
- Teachers need high-speed broadband access for professional development, and engaging in professional learning communities, as well as accessing new educational resources, such as curriculum cadres and education portals.
- Administrators need high-speed broadband access to conduct online assessments and to access data for effective decision making.
- Students need high-speed broadband access to overcome the digital divide in rural and low socio-economic areas.

To address these issues, SETDA made the following key recommendations:

In a technology-rich learning environment for the next 2-3 years, SETDA recommends:

- An external Internet connection to the Internet Service Provider of 10 Mbps per 1,000 students/staff
- Internal wide area network connections from the district to each school and between schools of at least 100 Mbps per 1,000 students/staff

In a technology-rich learning environment for the next 5-7 years, SETDA recommends:

- An external Internet connection to the Internet service provider of 100 Mbps per 1,000 students/staff.
- Internal wide area network connections from the district to each school and between schools of at least 1 Gbps per 1,000 students/staff.

NOTE: It is recommended that districts consider taking the 5-7-year perspective for technology infrastructure project planning purposes.

The full broadband report can be found at:
http://www.setda.org/c/document_library/get_file?folderId=270&name=DLFE-211.pdf

Additional SETDA reports can also be found at:
http://www.setda.org/web/guest/2020

C. Ubiquitous Access to Computing Resources for Teaching and Learning

Districts across the nation are implementing and evaluating a variety of approaches that allow students ubiquitous access to computing resources for teaching and learning. These approaches have been referred to as anywhere, anytime learning, one-to-one computing, laptop learning, or 24/7 access. In as much as the names differ, so do the possible approaches to achieving ubiquitous computing for the range of pre-K through high school students. The purchasing, funding, and dissemination strategies differ as do the computing devices, software alternatives, and network access.

Before exploring specific technology devices available in the educational marketplace, it is important to define the differing one-to-one environments and access strategies that can be created. The device might be any one of those described in greater detail in the next section, including a graphing calculator, handheld computer (PDAs), mini laptop/ultra portable, or laptop/tablet computer. Flexible use of these options may meet the various needs for differing learning audiences and communities:

- **Classroom- on- demand access:** This approach describes an environment where the classroom teacher can create a one-to-one ratio of learning devices to students within their classroom (or a cluster of classrooms) with little difficulty. For example, devices are used from class to class, and although the same device might be consistently assigned to specific students for tracking purposes, the students do not generally keep the device with them.
- **One- to- one access within the school environment:** This approach describes a strategy where students are assigned a learning device that they keep with them throughout the school day. Students in middle and high school take the device with them from class to class, using it for projects, note taking, scheduling, research, and content-specific activities. At the end of the day, the devices are returned to a central, secured location for recharging overnight. In this model, the learning devices generally do not leave the school facilities or leave on a case-by-case basis only.
- **One- to- one access 24/7:** This approach describes a strategy where students are assigned a specific learning device that they keep with them throughout the school year. They are generally allowed to take the device home as needed to complete assignments and conduct research.

Different learning devices are available for different developmental age groups, distribution/access approaches, and networking strategies. Providing a device per child by purchasing classroom sets of these individual computing devices has proven effective and even affordable. This section presents an overview of three different one-to-one strategies available for in-depth investigation by New Jersey Schools

1. Less than fully functional computing devices selling for under $200 per device that serve a specific purpose or complement fully-

functioned computers, for example, Neo[3], Dana, the Leapfrog collection, graphing calculators.

2. Mini-laptop/ultra portable computers with networking capacity currently priced from $200 to $400 per device, but expected to drop as demand and production increases (for example the XO One Laptop Per Child device, Intel's Classmate PC, Asus Eee PC, HP's mini-laptop).
3. Fully featured portable laptop computers or tablets that are Internet-ready, using wireless technology to connect to networks and the Internet available for less than $1,000 per device in volume purchases.

In the near future, students and parents will expect school resources for all students to include wireless portable devices that provide high-speed access to a broad array of educational, informational, recreational, and social-networking tools.

An overview of these one-to-one computing resources is included in Section 4. Administrative and Learning Environments, Subsection II. Instructional Environments, B. Ubiquitous Computing Strategies.

Benefits and Challenges

The *benefits* of employing portable one-to-one computing solutions are numerous:

- Resources can be moved ondemand to minimize down-time of technology resources and maximize return on investment.
- Mobile devices can be used, put away and reused as class time and activities require, becoming more of a learning tool and less the focus of instruction.
- Wireless and infrared capacity supports the sharing and "beaming" of information from student to student.
- Resources can be taken from within the classroom into the world to collect data outside, on field trips, in the halls, and in other environments not equipped with computing resources.

Likewise, a number of *challenges* have also been identified, examples include:

- Smaller and more portable devices that are more vulnerable to theft, damage, and loss.
- Longevity of rechargeable and conventional batteries and the need to continuously recharge batteries in a logical fashion can cause usability issues with shared resources.
- One-to-one computing environments that increase demand on infrastructure and bandwidth.

[3] Please note: throughout this guide a number of commercially available educational computing devices are listed as examples. This is in no way intended as an endorsement for these specific products, but is necessary in order to properly describe the growing field of mobile computing devices and instructional technologies that currently populate schools across the nation. It is acknowledged that, given the pace of technology change, the devices mentioned may be replaced or obsolete in the near future. Such instances will be addressed in subsequent revisions to this facilities guide.

- Movement of carts or cabinets in multiple-level facilities can raise safety concerns, as well as access issues in modular and relocatable classrooms.
- Ongoing maintenance of portable devices can also become a challenge for school tech support staff, if not properly planned and managed.
- Staying current with appropriate devices can be a challenge for schools with limited flexibility in budgeting resources.

III. Guiding Trends and Assumptions

The following are some technology-related trends and assumptions upon which this document is based:

A. Moore's Law

The original extrapolation made by George Moore in 1965 stated, "Since the invention of the integrated circuit in 1958, the number of transistors that can be placed inexpensively on an integrated circuit has increased exponentially, doubling approximately every two years". For the purposes of this document, the ongoing rapid advance in computing power per unit cost is acknowledged. This continuing processing power increase impacts a school's local and wide area networks and needs to be considered by the design consultant.

B. IP Convergence

The term *convergence* is commonly used in reference to the synergistic combination of voice and telephony features, data and productivity applications, and video onto a single network. These previously separate technologies are now able to share resources and interact with each other creating new efficiencies.

As more devices, such as surveillance cameras and hallway speakers, are made to run via Internet protocol (IP), IP convergence will continue to grow along with the need for bandwidth, which will increase the importance of efficient/effective use of that bandwidth. Networks should ultimately be designed to deliver broadband high-speed access to the desktop, in addition to supplying enough bandwidth for convergence.

C. Power, Cooling and Space Planning

IP Convergence, wireless devices and applications and higher-speed network devices will continue to grow and evolve. The equipment racks and spaces that hold or support these devices will require more power, more cooling and strategic space allocation, though the use of virtual server technologies can help reduce costs. Early design-stage planning of architectural and engineering requirements will be critical.

D. Wireless Impact in Educational Facilities and the Community

Wireless devices will continue to proliferate. The growth will not be confined to computing and communication devices, such as laptops, handhelds, and cell phones. Wireless technology will continue to spread to other disciplines that include: wireless clocks, wireless security cameras, wireless audio visual systems, interactive response etc. The required wireless coverage area will expand

outside the walls of the school to encompass courtyards, play areas, athletic fields and parking lots and thereby impact the neighboring community.

E. Protecting What Matters Most – Data and Physical Security Planning

The importance of securing data for students, teachers and administrators will increase as more applications and content are created and stored on the network. The tolerance for network downtime will decrease.

The physical security of students, school personnel, and school property will continue to be of paramount importance and command greater design and budgetary attention during the planning stages.

F. Interactive Technologies

Web 2.0 type tools (i.e. wikis, blogs, podcasts) will continue to gain a larger foothold in the teaching and learning environment. Likewise, multi-user virtual environments (MUVEs), such as Second Life, will bring lifelike worlds into the classroom. Avenues for incorporating online, interactive gaming technologies, both the use of and creation of by students, need to expand. The design consultant must recognize that these technologies impact bandwidth use and school/district administrators must consider these interactive technologies when developing acceptable use and filtering policies.

G. One- to- one Computing

Equitable student access to laptops, tablets and other handheld devices will continue to increase both onsite and offsite. Planning committee discussions, design consultant programming efforts and supporting infrastructure design must all reflect this concept.

H. Home/Remote eLearning /Virtual Learning

Planning processes, infrastructure, communications systems, and AV systems must all anticipate an increase in alternative learning/teaching locations that may occur twenty-four hours a day, seven days a week. As stated in Section F above, this increase presents issues for both the technology system/network designers and the policy makers.

IV. New Role of Schools

Twenty-first century schools must prepare students to compete in an increasingly global marketplace where innovation, information, and services are as highly valued as manufacturing products were one hundred years ago. This changing role places new demands on facilities, staffing, and resources as needs and audiences grow and change. This section of the facilities guide focuses on how schools/districts must respond to the following:

- New School Spaces for Evolving Roles
- New School Spaces for New Literacies
- Identifying Traditional and Non-traditional Activity Areas for New Audiences

A. New School Spaces for Evolving Roles

Students of the 21st century are life-long learners and can no longer be successful as passive recipients of knowledge focused only on processing prescribed information. Rather, they must assume the role of seeker and processor of information and creator of knowledge. As stated by former President Bill Clinton, "…what you earn depends on what you can learn. Not only what you know today, but what you are capable of learning tomorrow."

The *National Educational Technology Standards for Students* (NETS·S), revised in 2007, states very clearly on page 6 of the second edition booklet, "The World Has Changed and So Must We". Included in the NETS·S booklet is the below updated version of "traditional" versus "emerging" environments required to support 21st century learning and learners.

From the NETS·S booklet, the following chart lists characteristics representing traditional approaches to learning and corresponding strategies often associated with new learning environments.

Traditional Environments		***Emerging Learning Landscape***
Teacher-directed, memory-focused instruction	→	Student-centered, performance focused learning
Lockstep, prescribed-path progression	→	Flexible progression with multipath options
Limited media, single-sense stimulation	→	Media-rich, multisensory stimulation
Knowledge from limited, authoritative sources	→	Learner constructed knowledge from multiple information sources and experiences
Isolated work on invented exercises	→	Collaborative work on authentic, real-world projects
Mastery of fixed content and specified processes	→	Student engagement in definition, design, and management of projects
Factual, literal thinking for competence	→	Creative thinking for innovative and original solutions
In-school expertise, content, and activities	→	Global expertise, information, and learning experiences
Stand-alone communication and information tools	→	Converging information and communication systems
Traditional literacy and communication skills	→	Digital literacies and communication skills
Primary focus on school and local community	→	Expanded focus including digital global citizenship
Isolated assessment of learning	→	Integrated assessment of learning

The traditional classroom with rows of desks, a schedule of 50-minute classes, and curriculum consisting of memorization of discrete facts no longer aligns well with this vision of the *emerging learning landscape*. Instead, public education needs to embrace spaces that are flexible and promote group and collaborative efforts; schedules that allow for engaged, project-based learning; and curriculum that encourages interdisciplinary and cross-curricular research and exploration.

B. New School Spaces for New Literacies

The requirements for enhanced learning environments are defined by our changing world and the literacies necessary to be successful and productive citizens and workers. Nationally recognized groups, such as the International Society for Technology in Education (ISTE), the Partnership for 21st Century Skills, and many other corporate/education partnerships have comprehensively articulated these literacies. An overview that outlines the current thinking with respect to "new literacies" by respected professional organizations is located in Appendix B. More detailed information may be found on each respective Web site.

21st Century Skills and ICT Literacy

The *Learning for the 21st Century* report published by the Partnership for 21st Century Skills (www.21stcenturyskills.org) presents six **Key Elements of a 21st Century Education** that help define the requirements for 21st century learning environments:

1. Emphasize core subjects.
2. Emphasize learning skills.
3. Use 21st century tools to develop learning skills.
4. Teach and learn in a 21st century context.
5. Teach and learn 21st century content.
6. Use 21st century assessments that measure 21st century skills.

See Appendix B for more information on this subject.

NETS•S ~ National Educational Technology Standards for Students (Second Edition 2007)

The second edition of the NETS•S standards (www.iste.org/nets) was released in the summer of 2007. The newly released standards place greater emphasis on skills and expertise and less focus on the technology tools themselves.

These standards address six foundation areas:

- Creativity and Innovation
- Communication and Collaboration
- Research and Information Fluency
- Critical Thinking, Problem-Solving, and Decision-Making
- Digital Citizenship
- Technology Operations and Concepts

NETS·S also identifies thirteen essential conditions necessary to effectively leverage technology for learning. These essential conditions validate the critical success factors listed in Section 1 - III of this document.

Links to the New Jersey State Technology Plan

The recommendations and standards outlined in this facilities guide are intended to support and align directly to the goals presented in the New Jersey state technology plan. (*Preparing Today for Tomorrow: The Educational Technology Plan for New Jersey*)

The four New Jersey state **goals** for the integration of technology are:

GOAL 1: All students will be prepared to excel in the community, work place and in our global society using 21st century skills.

GOAL 2: All educators, including administrators, will attain the 21st century skills and knowledge necessary to effectively integrate educational technology in order to enable students to achieve the goals of the Core Curriculum Content Standards and experience success in a global society.

GOAL 3: Educational technology will be accessible by students, teachers and administrators and utilized for instructional and administrative purposes in all learning environments, including classrooms, library media centers, and other educational settings such as community centers and libraries.

GOAL 4: New Jersey school districts will establish and maintain the technology infrastructure necessary for all students, administrators and staff to safely access digital information on demand and to communicate virtually.

This facilities guide is a resource developed by the state to support the many audiences involved in new school design, construction, and renovations/retrofits as noted in the examples of assistance that will be provided by the NJDOE.

C. Identifying Traditional and Non- traditional Activity Areas for New Audiences

This section of the Facilities Guide presents an overview of traditional and non-traditional activity areas for students, parents, and community members. The topics addressed include:

- "Anytime, Anywhere Learning"
- Serving Multiple Audiences, Each with Multiple Roles
- Students and Teachers as Producers of Content
- Community Learning and Gathering Spaces

The impact on facilities design of these traditional and nontraditional activity areas are presented in greater detail in Section 4 of this guide.

"Anytime, Anywhere Learning"

Definitive research supporting the integration of instructional technologies to improve student academic performance has been a challenge for school districts across the nation. Finally, a few large-scale projects that have been carefully and closely monitored and evaluated are offering definitive results. In fall 2007, the Maine one-to-one laptop program (launched in 2002) announced improved scores on writing skills assessment. "The first in a series of studies aimed at evaluating Maine's pioneering laptop program, *Maine's Middle School Laptop Program: Creating Better Writers* concludes that the use of laptops improves scores on writing skills assessments, that more frequent use is linked to higher scores, and that writing skills of laptop users transfer to writing without a laptop." The full text of this article titled, *A research study from the University of Southern Maine shows that the state's one-to-one laptop program improves scores on writing skills assessments*, by Mary Axelson can be found at: http://www.k12blueprint.com/k12/blueprint/story_good_news_from_maine_about_the_impact_of_laptops_on_writing_skills.php . The full research report by the Maine Education Policy Research Institute (MEPRI) at the University of Southern Maine is located at: http://www.usm.maine.edu/cepare.

Harvest Park Middle School, located in Pleasanton Unified School District in Pleasanton, California, established its Laptop Immersion Program in 2001. Results indicate that Harvest Park Middle School students in the Laptop Immersion Program attained higher GPAs and end-of-course grades than nonparticipating students in their respective grades. Also, a substantially higher percentage of laptop students met or exceeded grade-level expectations in writing compared to Harvest Park school-wide averages and district-wide averages. And lastly, the California State Tests results indicate that a notably higher percentage of students enrolled in the Laptop Immersion Program at Harvest Park Middle School, across all grade levels, met or exceeded state content standards in English-language arts and mathematics when compared to their non-laptop counterparts.[4]

To support "anytime, anywhere learning", wireless networks, remote access, and one-to-one initiatives are encouraged in all schools.

Serving Multiple Audiences, Each with Multiple Roles

From early learner to adult, the 21st century learner experiences multiple roles and a wide variety of opportunities for learning. Throughout the school day, the learner may assume the role of writer, mathematician, scientist, musician, artist, researcher, producer, publisher, entrepreneur, or inventor. It is the responsibility of school district leadership to provide developmentally appropriate and challenging learning environments to support the work of its learner population in the many roles it is likely to assume during the course of its learning experience. Learning environment configurations with the capacity to address such diversity must be flexible, adaptable, powerful, and sophisticated, yet intuitive enough for an intended audience to use with ease. The following provides examples of the ways in which technology resources support the multiple roles of the 21st century learner.

[4] James Cengiz Gulek & Hakan Demirtas, "Learning With Technology: The Impact of Laptop Use on Student Achievement", The Journal of Technology, Learning and Assessment, Volume 3, Number 2 · January 2005

Mathematician

The world of the mathematician includes mastery of basic computation skills, practice with gathering, manipulating, and interpreting numerical quantities, contexts to write and communicate mathematical ideas, and real-world opportunities to apply his or her skills.

Scientist

The scientist learns to ask questions, theorize, develop hypotheses, and conduct experiments in an attempt to support or refute ideas. The scientist's ability to access research data in his or her field of studies, consult and collaborate with local, national, and global experts, collect, store, and manipulate findings for analysis, and present findings in a logical and understandable format for global peer review are greatly enhanced by technology resources.

Explorer/Researcher

As Internet access spreads and bandwidth increases, international borders seemingly disappear and our world appears to grow ever smaller. Whether the topic of his investigations includes the study of history, geography, government, or economics, the student researcher of the 21st century must master navigation, selection, critical thinking and evaluation, information discrimination/validation, documentation skills, and publishing for global peer review.

Writer/Publisher/Presenter

From the creation and publication of a child's first story to the production of a high school yearbook, writing and publishing tools have infiltrated educational learning environments across the nation. Publishing houses in elementary schools are busy laminating stories written and illustrated with easy-to-use word processing programs. Middle-school students regularly produce and publish weekly or monthly school newsletters. At the high school level, students are engaged in professional quality desktop publishing and graphic design activities for community businesses and organizations.

Arts and Music

The study of fine arts, composition of musical arrangements, and creation of artistic works can be enhanced and supported with learning environments rich in arts and music digital devices and applications. The primary learner begins with easy-to-use, yet powerful point and click applications, while middle and high school students frequently have access to nearly commercial-quality graphic design, MIDI resources, live recordings and videos.

Global/Health Citizen

The concepts of personal wellness and individual participation in a global community begin in the earliest grades, and are reinforced throughout the school years. Beginning with a basic knowledge of food groups and nutrition and progressing to a complex understanding of body functions, chemistry, and systems, multiple technologies support health and physical education programs. The ability to communicate online with peers and experts globally and locally significantly enhances our understanding of other cultures and nations.

Entrepreneur/Inventor/Engineer

The popularity in 2008 - 2009 of national and global programs such as Olympics of the Mind (OM), Thinkquest, Destination Imagination (DI), FIRST Lego League (FLL), FIRST Vex Challenge, (FVC), and the FIRST Robotics (FRC) competitions coupled with school-based Invention Conventions highlight the power and potential of technology resources to create, test, and refine inventions, as well as design, develop, produce, and market products, or identify and solve problems.

Lifelong Learner

Gifted or challenged, young or old, novice or expert, each of us are travelers on a lifelong learning journey. The appropriate use of and access to technology resources gives individuals in all stages of life, all occupations, and interest levels vast information resources, powerful productivity tools, easy communication channels, easy-to-use organizers, and exciting methods of expression and global outreach.

Students & Teachers and Producers of Content

Students and teachers have become co-learners and partners in learning and knowledge creation. No longer just a consumer of content, the 21st century learner is also a producer and publisher of important content that should be shared with local, national and global audiences. Projects and research result in products that may be created in a variety of digital formats including text, audio, video, and Web site content. Just a few examples include:

- Think.com is now part of ThinkQuest -- A learning platform where teachers and students create learning projects, participate in a Web site competition, and browse a library of student projects http://www.thinkquest.org/en/
- Powerful and moving videos created for the Mabry Film Festival by students at the Mabry Middle School in Mabry, Georgia (http://mabryonline.org/archives/2007/04/2007_film_festi.html).
- The Flickschool program started by Marco Torres and Veronica Marek located in San Fernando, California, comprised of the San Fernando Education Technology Team (SFETT) that also engages students in exciting and compelling video production (www.sfett.com/)
- Exemplary Web sites and animations created annually by high school students as a component of the FIRST Robotics Competition (FRC) (www.usfirst.org)

Resulting songs, animations, videos, Web sites, and presentations all require digital tools and space, resources, supervision for development and server space for storage, management, and distribution of final products.

Community Learning and Gathering Spaces

As district leadership explores strategies to extend the use of school resources to members of their greater community, they need to consider the impact of these audiences on the resources to which they will desire/require access and facilities they will frequent. External access to and from frequented areas,

security for the remainder of the building, and technical support and staffing during nontraditional school hours all impact school design considerations.

Recommended configurations and technology components for these areas that the community will access are discussed in greater detail in Section 4:

- Instructional Environments – classrooms, computer labs and computer classrooms
- Shared Environments - library media center, distance and virtual learning environments, and video production and distribution environments
- Large Group Environments - auditorium/theater, cafetorium/multipurpose area, gymnasium/athletic field

Access by multiple audiences during nontraditional school hours will require facilities that present models of **flexible use of space** and include **strategic placement of technology resources.** New school facilities should be planned and designed with the anticipation that they will be open before and after the traditional school day. Access, egress, and security strategies need to be considered in the total design process.